RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6688
CK6688A

RELIABLE MINIATURE PENTODE

The CK6688 and CK6688A are heater-cathode type, high transconductance, sharp-cutoff pentodes of miniature construction utilizing a frame grid and are designed for wide-band amplifier service. It is a reliable quality tube designed for dependable operation under condition of shock and vibration encountered in critical industrial and military applications.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration (Shock)	450 G
Fatigue (Vibrational Acceleration for Extended Periods	2.5 G
Bulb Temperature	155 °C
Altitude	60,000 Ft

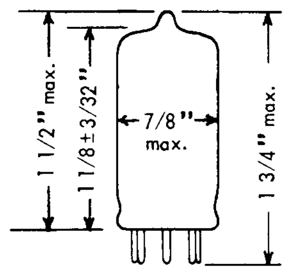
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Units
		Ratings				
Heater Voltage	Ef:	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	---	190	190	210	Vdc
Grid #1 Voltage	Ec1	–50	+9	+9	0	Vdc
Grid #2 Voltage	Ec2:	---	160	160	175	Vdc
Grid #3 Voltage	Ec3:	---	0	0	0	Vdc
Cathode Resistance	Rk:	---	630	630	---	ohms
Plate Dissipation (Design Max.)	Pp:	---	---	---	2.7	Watts
Grid #2 Dissipation (Design Max.)	Pg2:	---	---	---	0.6	Watts
Heater–Cathode Voltage	Ehk:	---	---	---	60	v
Grid Resistance	Rg1:	---	---	---	0.1	Meg.
Cathode Current	Ik:	---	---	---	25	mAdc
Peak Negative Grid #1 Voltage	ec1:	---	---	---	–100	v

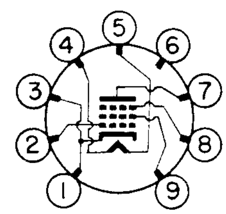
MECHANICAL DATA

ENVELOPE	Glass T–6½
OUTLINE	6–6
BASE	E9–1
BASING	9EQ
CATHODE	Unipotential
MOUNTING POSITION	Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Cathode
Pin 2	Grid Number 1
Pin 3	Cathode
Pin 4	Heater
Pin 5	Heater
Pin 6	Internal Connection
Pin 7	Plate
Pin 8	Internal Shield and Grid No. 3 (Suppressor)
Pin 9	Grid No. 2 (Screen)

ELECTRICAL DATA (cont'd)

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Units
			Tests			
Heater Current	If:	285	300	...	315	mA
Plate Current (1) Ebb=180 Vdc, Ec1=Ec3=0 Ec2=150 Vdc, Rk=78 ohms	Ib:	8	13	...	18	mAdc
Grid #2 Current	Ic2:	2.9	3.3	...	3.7	mAdc
Transconductance	Sm:	14,200	16,500	...	18,800	μmhos
Plate Resistance (Approx.)	rp:	...	0.09	...	...	Meg.
Plate Current (2) Ec1=−6 Vdc	Ib:	...	...	...	100	μAdc
Capacitance (Note A)	Cgp:	...	...	...	0.03	pf
Capacitance (Note A)	Cin:	6.7	7.5	...	8.5	pf
Capacitance (Note A)	Cout:	2.5	3.0	...	3.5	pf

Note A: With external shield. Pin #6 is left floating.

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450 G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater–Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions. Ef=7.5V; Ehk=+60Vdc and other elements floating. At the conclusion of this test the tubes will not show open heater, cathode circuits or heater–cathode short, and meet a maximum Ihk leakage limit of 20 μAdc.

Stability Life Test – Sample is operated for two and twenty hours to assure initial electrical stability ($\Delta_t Sm < 10\%$).

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 155°C.

Altitude – Sample is subjected to a pressure of 55±5 mm Hg to assure freedom from flashover or corona at the pins of the tube.

APPLICATION NOTES

CAUTION – – – To Electron Equipment Design Engineers. Special attention should be given to the temperature which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL–E–1.

For miscellaneous requirements, see 3.6.

TEST CONDITIONS

Ef=6.3 V
Eb=190 Vdc
Ec1=+9 Vdc
Ec2=160 V
Ec3=0 Vdc
Rk=630 ohms

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Insp. Level or Code	Symbol	LIMITS (See Note 2)						Units
						Min.	LAL	Bogie	UAL	Max.	ALD	
GENERAL												
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---	---	---	---	---
3.6	Performance		---	---	---	---	---	---	---	---	---	---
QUALIFICATION (SEE NOTE 3)												
---	Cathode	Coated Unipotential	---	---	---	---	---	---	---	---	---	---
3.4.3	Base connections		---	---	---	---	---	---	---	---	---	---
---	Sweep frequency vibration (1)	Ef=6.3 Vdc; Eb=180 Vdc; Ec2=150 Vdc; Rp=2000; RL/Ib=13 mAdc (see Note 4)	---	---	Ep:	---	---	---	---	500	---	mVac
MEASUREMENT ACCEPTANCE TESTS, PART 1 (SEE NOTE 5)												
4.10.8	Heater current		0.65	II	If:	285	---	---	---	315	---	mA
4.10.15	Heater–cathode leakage	Ehk=+100 Vdc	0.65	II	Ihk:	---	---	---	---	15	---	μAdc
		Ehk=–100 Vdc			Ihk:	---	---	---	---	15	---	μAdc
4.10.6.1	Total grid current		0.65	II	Ic1:	0	---	---	---	–0.5	---	μAdc

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Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Insp. Level or Code	Symbol	LIMITS (See Note 2) Min.	LAL	Bogie	UAL	Max.	ALD	Units
MEASUREMENT ACCEPTANCE TESTS, PART 1 (SEE NOTE 5) Cont'd.												
4.10.4.1	Plate current (1)	Ebb=180 Vdc; Ecc1=150 Vdc; Ecc2=150 Vdc; Ecc3=0 Vdc; Ek=78 ohms	---	---	Ib:	---	11.0	13.0	15.0	---	5.0	mAdc
4.10.4.1	Plate current (1)		0.65	II		8.0	---	---	---	18.0	---	mAdc
4.10.4.1	Plate current (2)	Ec1=−6.0 Vdc	0.65	II	Ib:	---	---	---	---	100	---	µAdc
4.10.4.3	Screen–grid current		---	---	Ic2:	---	3.1	3.3	3.5	---	0.3	mAdc
4.10.4.3	Screen–grid current		0.65	II	Ic2:	2.9	---	---	---	3.7	---	mAdc
4.10.9	Transconductance (1)		---	---	Sm:	---	15,000	16,500	18,000	---	2,500	µmhos
4.10.9	Transconductance (1)		0.65	II	Sm:	14,200	---	---	---	18,800	---	µmhos
4.7.5	Continuity and short tests (for reliable tubes) (inoperative)		0.65	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical–production tests	Outline 6–6	---	---	---	---	---	---	---	---	---	---
MEASUREMENT ACCEPTANCE TESTS, PART 2												
4.8	Insulation of electrodes	g1–all p–all	2.5	L6	R: R:	20 20	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.9	Transconductance (2)	Ef=5.7 V	2.5	I	Δ_{Ef}Sm	---	---	---	---	15	---	%
4.10.6.2	Grid emission	Ef=7.5 V Ec1=−6.0 Vdc; Rk=0 (see note 6)	2.5	I	Ic1:	0	---	---	---	−0.5	---	µAdc
4.10.3.1	Radio–frequency noise (other than shot–effect noise)	Ecal=30 mVac (see note 7)	2.5	I	---	---	---	---	---	---	---	---
4.10.3.4	Noise and micro–phonics (for re–liable receiving tubes)	Ef=6.3, Ehk=0; Ebb=Ecc2=200; Ec1=0; Ecal=600 mVac; Rk=1000; Rp=0.1 Meg; Rg2=0.5 Meg; Ck=1000 µf; Cg2=3 µf (see note 8)	2.5	I	---	---	---	---	---	---	---	---
4.10.14	Direct interelectrode capacitance	Shield No. 315 (see note 9) Shield No. 315 (see note 9) Shield No. 315 (see note 9)	6.5	Code E	Cg1p: Cin: Cout:	--- 6.7 2.50	--- --- ---	--- --- ---	--- --- ---	0.030 8.5 3.50	--- --- ---	pf pf pf
4.9.12.1	Low–pressure volt–age breakdown	Pressure=55+5 mm Hg; voltage=500 Vac	6.5	(See note 10)	---	---	---	---	---	---	---	---
4.9.10.1	Low–frequency vibration (2)	Rp=2000	6.5	Code I	Ep:	---	---	---	---	300	---	mVac

RELIABLE MINIATURE PENTODE

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Insp. Level or Code	Symbol	LIMITS (See Note 2) Min.	LAL	Bogie	UAL	Max.	ALD	Units
DEGRADATION RATE ACCEPTANCE TESTS (SEE NOTE 11)												
4.9.20.5	Shock test	Hammer angle=30° Ehk=+100 Vdc (see note 12)	---	---	---	---	---	---	---	---	---	---
4.9.20 .6	Fatigue test	G=2.5; F=25 min. 60 max; fixed frequency	6.5	(See note 10)	---	---	---	---	---	---	---	---
---	Post shock and fatigue test end points	Vibration (2)	---	---	Ep:	---	---	---	---	400	---	mVac
		Heater–cathode leakage Ehk=+100 Vdc	---	---	Ihk:	---	---	---	---	30	---	µAdc
		Ehk=–100 Vdc	---	---	Ihk:	---	---	---	---	30	---	µAdc
		Transconductance (1)	---	---	Sm:	12,500	---	---	---	---	---	µmhos
		Grid current	---		Ic1:	0	---	---	---	–1.0	---	µAdc
4.9.6.1	Miniature–tube base–strain		---	---	---	---	---	---	---	---	---	---
4.9.6.3	Glass strain (for receiving tubes)	(See note 13)	2.5	I	---	---	---	---	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Insp. Level or Code	Allowable Defectives per Characteristic: First sample	Combined samples	Symbol	LIMITS Min.	Max.	Unit
ACCEPTANCE LIFE TESTS (SEE NOTE 11)										
4.11.7	Heater–cycling life test	Ef=7.5 V; Ehk=60 Vdc; Eb=Ec1=Ec2=0 (see note 14)	---	---	---	---	---	---	---	---
4.11.4	Life–test end points	Heater–cathode leakage Ehk=+100 Vdc	---	---	---	---	Ihk	---	20	µAdc
		Ehk=–100 Vdc	---	---	---	---	Ihk	---	20	µAdc
4.11.3.1(a)	Stability life test	Eb=200 Vdc; Ec1=+9 Vdc; Ec2=170 Vdc; Ec3=0; Rk=680; Rg1=0.5 Meg; TA=room (see note 15)	1.0	Code I	---	---	---	---	---	---
4.11.4	Life–test end point (stability)	Change in transconductance (1) of individual tubes	---	---	---	---	Δ_tSm	---	10	%
4.11.3.1(b)	Survival–rate life test	Stability life test conditions, or equivalent (see notes 16 and 17)	---	II	---	---	---	---	---	---

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Par. No.	Test	Conditions	AQL (Percent Defective)	Insp. Level or Code	Allowable Defectives per characteristic		Symbol	LIMITS		Unit
					First sample	Combined samples		Min.	Max.	
ACCEPTANCE LIFE TESTS (SEE NOTE 11) Cont'd										
4.11.4	Life–test end points (100 hours)	Continuity and shorts (inoperatives)	0.65	---	---	---	---	---	---	---
		Transconductance (1)	1.0	---	---	---	Δ_tSm	---	15	%
4.11.5	Intermittent life–test operation	Stability life test conditions; T (envelope)=+155° C min (see notes 18 and 19)	---	---	---	---	---	---	---	---
4.11.4	Life–test end points (500 hours)	(See note 20)								
		Inoperatives (see note 21)	---	---	1	3	---	---	---	---
		Grid current	---	---	1	3	Icl	0	–0.9	µAdc
		Heater current	---	---	1	3	If	285	315	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_tSm	---	20	%
		Transconductance (2)	---	---	2	5	Δ_{Ef}Sm	---	15	%
		Heater–cathode leakage Ehk=+100 Vdc	---	---	1	3	Ihk	---	20	µAdc
		Ehk=–100 Vdc					Ihk	---	20	µAdc
		Insulation of electrodes g1–all	---	---	2	5	R	10	---	Meg
		p–all					R	10	---	Meg
		Transconductance (1) average change	---	---	---	---	AvgΔ_tSm	---	15	%
		Total defectives	---	---	4	8	---	---	---	---
4.11.4	Life–test end points (1000 hours)	(See note 20)								
		Inoperatives (see note 21)	---	---	2	5	---	---	---	---
		Grid current	---	---	2	5	Icl	0	–0.9	µAdc
		Heater current	---	---	2	5	If	285	315	mA
		Change in transconductance (1) of individual tubes	---	---	2	5	Δ_tSm	---	25	%
		Heater–cathode leakage Ehk=+100 Vdc	---	---	2	5	Ihk	---	20	µAdc
		Ehk=–100 Vdc					Ihk	---	20	µAdc
		Insulation of electrodes g1–all	---	---	3	5	R	10	---	Meg
		p–all					R	10	---	Meg
		Total defectives	---	---	5	10	---	---	---	---
4.9.10	Container drop	(d) Package group 1; Container size B								

NOTE 1: The sequence of tests listed herein is the suggested order in which the tests should be conducted.

NOTE 2: Variable sampling. See 4.1.1.7.

NOTE 3: All tests listed herein shall be performed during qualification inspection; however, these three tests are normally performed during qualification inspection only.

NOTE 4: Sweep frequency vibration. The tubes shall be fastened rigidly to the vibration platform and vibrated with simple harmonic motion over a frequency range of 50 to 500 cps at an acceleration value of 2.5 G. The acceleration over the frequency range shall be within ±30 percent of the reference acceleration at 100 cps. The frequency shall increase from 50 to 500 cps with approximately logarithmic progression and shall require 4 minutes minimum, 5 minutes maximum, to traverse the range. Each tube shall be vibrated in positions X1 and X2, except that if the cumulative result of test on 50 or more tubes of a construction show that more than 75 percent of the tubes have higher output voltages in one position, subsequent measurements need to be taken only in the position giving the higher readings. The tubes shall be tested with the specified voltages applied thereto during vibration. The value of Ebb shall be the same as the value of Eb under the test conditions and shall be applied to the tube through the specified resistor, Rp. The value of the alternating voltage, Ep, produced across the resistor Rp, as a result of vibration, shall be measured with a suitable device. This device shall have an appropriate voltage range; shall have the ability to measure, with an error of less than 10 percent, the rms value of a sine wave of voltage at all frequencies from 20 to 5000 cps; and shall have dynamic response characteristics equivalent to or faster than a VU meter (as described in Publication ASA Standard No. C16.5-1954). The value of Ep shall not exceed the limit specified at any point in the frequency range, nor shall this test result in open circuits, permanent shorts, or tap shorts as specified in 4.7.1, 4.7.2, and 4.7.3.

NOTE 5: The AQL for the combined defectives for attributes in measurements acceptance tests, part 1, excluding inoperative and mechanical, shall be 1 percent.

NOTE 6: Prior to this test, tubes shall be preheated a minimum of 5 minutes at the conditions indicated below. Three-minute test is not permitted. Test at specified conditions within 3 seconds after preheating. Grid emission shall be the last test performed on the sample selected for the grid-emission test.

Ef	Ec1	Ec2	Eb	Rk
Vdc	Vdc	Vdc	Vdc	ohms
7.5	+9	160	190	630

NOTE 7: In addition to the rejection criteria of 4.10.3.1, the output shall be read on a VU meter using a rejection limit of 5 VU. Five VU is the meter deflection obtained with a steady output of 3 mW from the amplifier.

NOTE 8: The rejection level shall be set at the VU meter reading obtained during calibration.

NOTE 9: Pin 6 floating.

NOTE 10: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. Standard MIL-STD-105, sample size code letter F, shall apply.

NOTE 11: Destructive tests. Tubes subjected to the following destructive tests are not to be delivered on the contract or order.

4.9.20.5	Shock test	4.11.7	Heater-cycling test
4.9.20.6	Fatigue test	4.11.5	Intermittent life-test operation

NOTE 12: A grid resistor of 0.1 megohm shall be added; however, this resistor will not be used when a thyratron-type short indicator is employed.

NOTE 13: The following modifications apply to 4.9.6.3:

a. Replace fifth sentence with the following:

The holder shall be in accordance with Drawing 245-JAN and the tubes shall be immersed quickly.

b. Replace seventh sentence with the following:

After the 5-second submersion period, the tubes shall be removed and allowed to return to room temperature on a wooden surface.

NOTE 14: The no–load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot–by–lot basis. A failure or defect shall consist of an open heater, open cathode circuit, heater–cathode short, or heater–cathode leakage in excess of the specified heater–cycling life–test end point limit.

NOTE 15: Stability life test. The sampling and testing procedures for this test shall be in accordance with 20.2.5.1 of Appendix C.

NOTE 16: Survival–rate life test. The sampling and testing procedures for this test shall be as specified in 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

NOTE 17: For survival–rate life test, the equivalent stability–life–test conditions shall be as specified in 20.2.5.2.5 of Appendix C.

NOTE 18: Intermittent life test. See 20.2.5.3 of Appendix C.

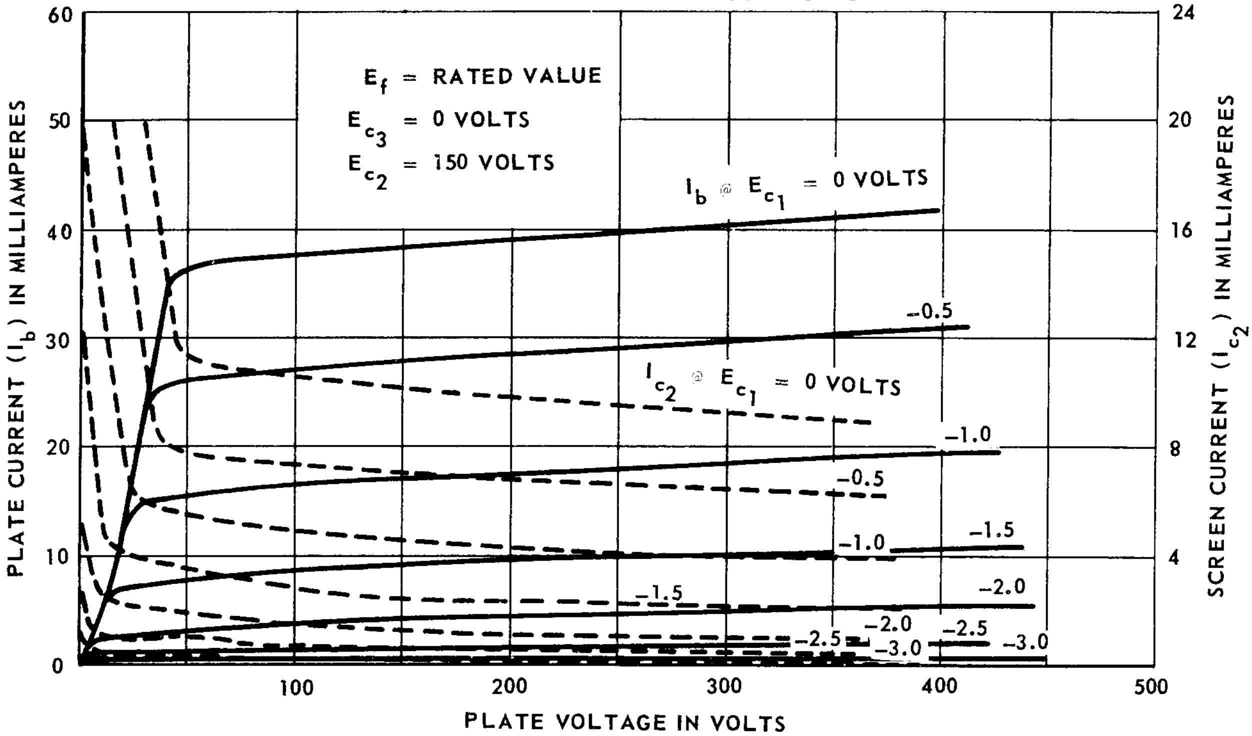
NOTE 19: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of 40 B&S or smaller diameter elements welded to a ring of 0.025–inch diameter phosphor bronze placed in contact with the envelope. Envelope temperature requirement will be satisfied if the tube, having bogie Ib±5 percent under normal test conditions, is determined to operate at minimum specified temperature at any position on the life–test rack.

NOTE 20: Order of evaluation for life test defects. See 4.11.3.1.2.

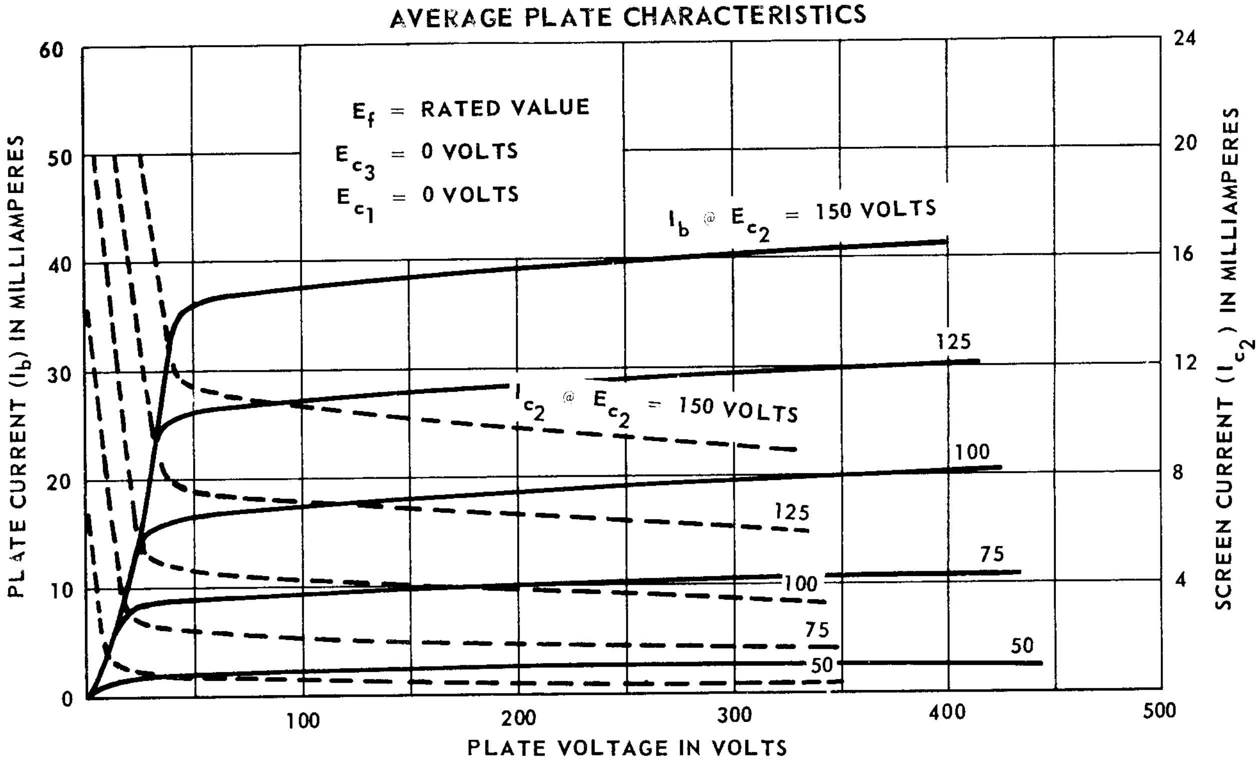
NOTE 21: An inoperative, as referenced in life test, is defined as a tube having one or more of the following defects: Discontinuity (see 4.7.1), permanent shorts (see 4.7.2), air leaks (see 4.7.6).

RELIABLE MINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS

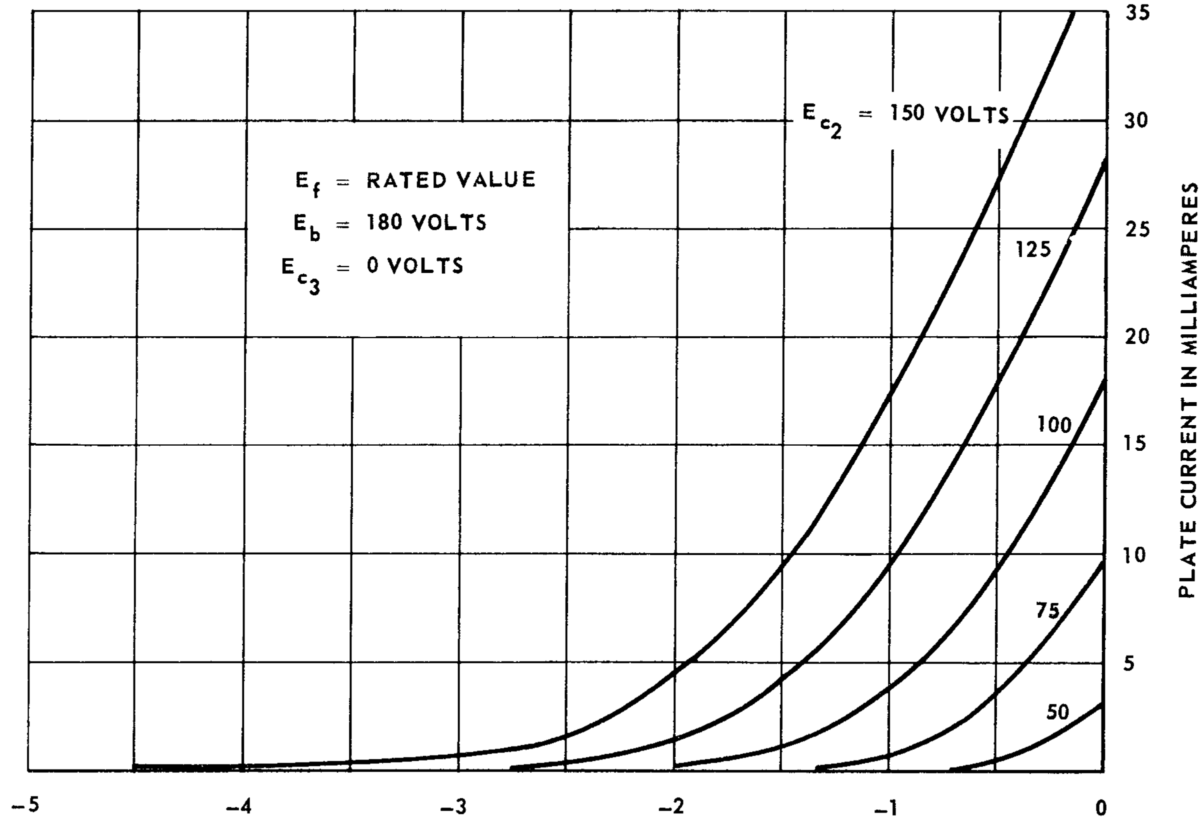


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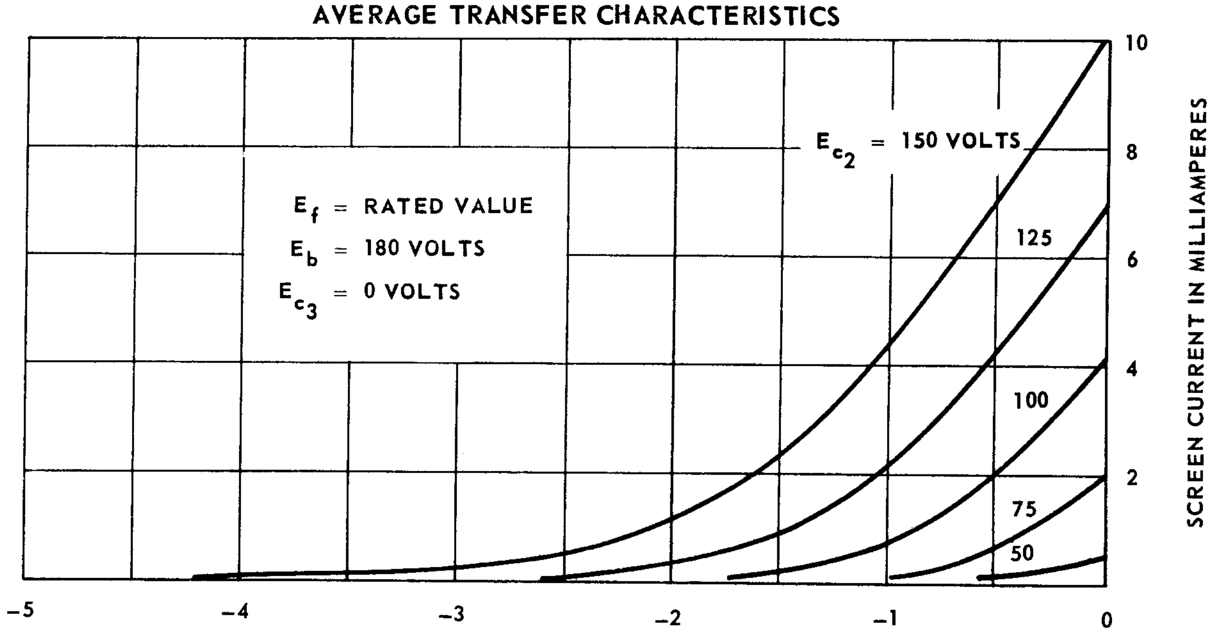
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RELIABLE MINIATURE PENTODE

AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



RELIABLE MINIATURE PENTODE

AVERAGE TRANSFER CHARACTERISTICS

